STUDIES ON THE SEASONAL LIFE HISTORY OF THREE SPECIES OF FRESHWATER OSTRACODS

BY
EDWARD FERGUSON, JR.
A.B., University of Illinois, 1929
M.S., University of Illinois, 1933

AN ABSTRACT OF A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
ZOOLOGY IN THE GRADUATE SCHOOL OF
THE UNIVERSITY OF ILLINOIS, 1942

URBANA, ILLINOIS
1942

STUDIES ON THE SEASONAL LIFE HISTORY OF THREE SPECIES OF FRESHWATER OSTRACODS

BY
EDWARD FERGUSON, JR.
A.B., University of Illinois, 1929
M.S., University of Illinois, 1933

AN ABSTRACT OF A THESIS
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN
ZOOLOGY IN THE GRADUATE SCHOOL OF
THE UNIVERSITY OF ILLINOIS, 1942

URBANA, ILLINOIS
1942

ACKNOWLEDGMENTS

The writer wishes to express his grateful appreciation for the many helpful suggestions, and the assistance rendered him by numerous friends during the course of his investigations incident to the preparation of this dissertation. Dr. Lester Ingle of the Department of Zoology of the University of Illinois gave suggestions on culture media and culture methods. Dr. C. C. Hoff of the Department of Biology of Quincy College gave fully of his time, and of his extensive knowledge of the group studied; he aided in the identification of the organisms comprising this study, and suggested significant points of procedure, particularly in connection with the study of progressive development of characters of importance in the classification of the Ostracoda. To the members of his immediate family the author offers a word of thanks for aid in the collection of materials, and for sympathetic understanding. Finally, to Professor H. J. Van Cleave, who suggested the problem, and under whose supervision this study was made, the writer owes a debt of gratitude. It was my privilege and pleasure to study as an undergraduate student under Dr. Van Cleave, and to work intermittently as a graduate student in his laboratory for more than nine years; the spirit which pervaded his classroom and research laboratory developed within his students ideals consistent with a truly democratic concept for which I am deeply grateful.

STUDIES ON THE SEASONAL LIFE HISTORY OF THREE SPECIES OF FRESHWATER OSTRACODS

From April 1941 to July 1942 more than four hundred samples of three freshwater ostracods, *Cypriodopsis vidua* (O. F. Müller 1776) Brady 1867, *Potamocypris smaragdina* (Vávra 1891) Daday 1900, and *Physocypria pustulosa* (Sharpe 1897) G. W. Müller 1912, were collected from an artificial lake located in Forest Park, Saint Louis, Missouri. A single habitat was chosen in the belief that in a life history study variable factors should be kept at a minimum; a single habitat more closely approximates this ideal than would be the case were several habitats used.

Samples were collected at intervals of approximately ten days throughout the period of this study, except during November 1941 when the lake had been drained, and February 1942 when the water was frozen to such depth as to preclude successful collection of materials.

Cultures of the three species of ostracods constituting the basis of this study were kept in the biological laboratories of the Stowe Teachers College, Saint Louis, as a check on field observations. The cultures kept in finger bowls and one gallon battery jars provided sufficient data upon which to make comparisons with conditions observed in the field.

A study of specimens preserved in alcohol, and of prepared microscopic mounts of *C. vidua*, *P. smaragdina*, and *P. pustulosa* provided the basis for the discussion of the morphology of the adult freshwater ostracods, and for the description of the shells and appendages of several instars of these three species.

From the evidence secured by observations made on laboratory cultures and field collections, and by a study of their morphology, the seasonal life history of each of the following freshwater ostracods has been discussed:

(a). *Cypriodopsis vidua*,
(b). *Potamocypris smaragdina*, and
(c). *Physocypria pustulosa*.

This investigation revealed the following significant facts relative to the seasonal life history of the three species studied:

(a). *Cypriodopsis vidua* has a seasonal range, at the latitude of Saint Louis, from March to December. This organism has two broods a year, the first from April to June, and the second from August to October; it reaches its peak of abundance during the July-October period, and is apparently a summer-autumn form. The duration of adult life for this species is approximately five months. It requires from seven to nine weeks for *C. vidua* to complete its metamorphosis from the three-appendage nauplius to the sexually mature individual.

(b). *Potamocypris smaragdina* has a seasonal range extending from late March to November, with a peak of abundance in the period from the third week in June until the third week in September. *P. smaragdina* is typically a summer form, and has two broods a year, one from late April to late June, and the other from mid-August to late October. The duration of adult life in this species is from fourteen to sixteen weeks; it requires from eight to ten weeks for *P. smaragdina* to complete its development.

(c). *Physocypria pustulosa* has a seasonal range from late March until October, reaching its greatest abundance in April. This ostracod has a single brood a year, which appears from mid-May to late July. *P. pustulosa* is typically a spring form, and requires from eight to ten weeks to complete its metamorphosis; the duration of adult life for this species is from eight to ten weeks.

Freshwater ostracods that reach their peak of adult abundance in the spring apparently have a single brood a year, a relatively short duration of adult life, and a comparatively short developmental period. Whereas, those freshwater ostracods that are typically summer or autumn, or summer-autumn forms appear to have at least two broods a year, a long duration of adult life, and a relatively long period of metamorphosis.

The freshwater ostracod leaves the egg as a nauplius possessing the first three pairs of cephalic appendages. During the period of development from the nauplius to the sex-

ually mature adult, the animal undergoes eight molts, and adds a fourth pair of cephalic appendages, the maxillae, three pairs of thoracic appendages, and the unsegmented ramus, the furca. The furca is considered to be homologous with the post-abdomen of the cladocerans.

In the nauplius of *P. smaragdina,* and of *P. pustulosa* the mandible has the same general form, except for size, that it has in the adult. No evidence of the three-segmented pediform stage of the mandible was seen in either of the species investigated. The anlagen of the reproductive glands appear among the freshwater Cypridae during the seventh instar; the sexually mature individual appears after the molting of the eighth instar.

A pair of appendages and / or a podomere are not added during each successive molt in the freshwater Cypridae as maintained for many of the arthropods. There are eight pairs of appendages, including the furca, in the ostracods. The first three pairs of appendages are present at the time the nauplius leaves the egg; development of the nauplius to the sexually mature animal involves eight successive molts, whereas only five pairs of appendages develop from anlagen during this metamorphosis. The greatest number of articles added to a single appendage is three in the first antenna, and in some species also in the second antenna. The antennae reach their definitive form during the seventh instar, thus only three podomeres are added during six molts. It was also observed that some appendages, for example the third thoracic appendage, appear during one instar and reach definitive form during the instar immediately following.

In *C. vidua, P. smaragdina,* and *P. pustulosa* the addition of podomeres to the first and second antennae results from the division of the basal and second articles.

A study of the seasonal distribution of males and females of *P. smaragdina* and *P. pustulosa* was made in order to determine if an alternation of parthenogenetic and syngamic reproduction regularly occurs among the freshwater ostracods. Both males and females of these two species were found during their entire period of seasonal occurrence. This sug-

gested that among these two species, and probably among other freshwater ostracods also, no regular alternation of parthenogenetic and syngamic reproduction occurs, and that reproduction in those species where both sexes are typically found is always syngamic.

Some ostracods show a local parthenogenesis; among the European species of the genus Potamocypris no males have been reported, hence reproduction is apparently always parthenogentic. In collections made of the single representative of this genus in our American fauna, *Potamocypris smaragdina*, males were found during the entire period of seasonal occurrence of the species, consequently, reproduction is doubtless always syngamic.

In the discussion on sexual dimorphism among freshwater ostracods a review of morphological characters peculiar to the male, or to the female was presented. An examination of the maximum length and maximum height of the shells of several hundred males and females of *P. smaragdina*, and of *P. pustulosa* indicated that males are essentially smaller than females. However, due to the intergradations of shell sizes many of the males of these two species had shells larger than the shells of some of the females of the same species, consequently, to make a determination of sex of a freshwater ostracod on the relative size of the shell alone would be misleading and possibly erroneous.

Certain problems associated with a study of the seasonal life history of ostracods, such as migration of organisms to deeper water, effect of wind or current, and the shifting to more favorable habitats all of which contribute to the sporadic and 'spotty' appearance of ostracods in a given habitat, have been mentioned in this thesis as topics demanding further observations.

A careful search of the literature reveals no previous published study concerning the seasonal life history of freshwater Ostracoda of North America. There have been several papers on the presence of North American ostracods in plankton samples, and on the morphology of the instars of several species of Ostracoda common in our American fauna, but none

of these include any observations on the progressive development of an ostracod through the several instars to the adult with reference to seasonal variations.

VITA

Edward Ferguson, Jr. was born January 6, 1907, at Dawson, Georgia. He attended the private and public schools of that city from 1912 to 1919. In September of 1919 he entered the eighth grade of the grammar school division of the Georgia Normal School, Albany, Georgia; he graduated from the high school of the latter institution in 1924. On June 12, 1929 he received the degree of Bachelor of Arts from the University of Illinois. From September 1929 until June 1932 he was instructor of biology in the State Agricultural and Mechanical College, Orangeburg, South Carolina. During the academic session of 1932-1933 he was a General Educational Board Fellow studying in the University of Illinois for the degree of Master of Science in Zoology. The University of Illinois awarded him the degree of Master of Science on June 12, 1933. From September 1933 until June 1936 he was professor of biology in the State A. and M.College, Orangeburg, South Carolina. He served as an instructor of biology in the Southern University and A. and M. College, Baton Rouge, Louisiana from September 1936 until July 1937, and in the same position from September 1938 until March 1940. During the eleven month period from September 1937 until August 1938 he studied in the Department of Zoology of the University of Illinois under a fellowship grant from the General Education Board of New York City. On March 11, 1940 he was appointed to the position of instructor of biology in the Sumner High School, Saint Louis, Missouri where he served until June 1941. In September 1941 he was transferred to the Stowe Teachers College of Saint Louis as instructor of biology, the position he now holds. He was the Omega Psi Phi Fraternity Fellow for 1941-42.

He was elected to associate membership in Sigma Xi in 1933, and to membership in Rho chapter of Phi Sigma in 1938. He is a member of the American Association for the Advancement of Science.

PUBLICATIONS

1940.—"A Revised List of Papers Published by Charles Henry Turner." Journal of Negro Education, IX (4) : 658-660.

1941.—"The Relationship Between High School Courses in Biology and General Science and the Grades Obtained by Students in First Year College Biology." Journal of Negro Education, X (4) : 667-669.

1941.—"The Instructional and Non-Instructional Staff Members of Twenty-eight Negro Colleges." Journal of Higher Education Among Negroes, IX (4) : 168-173.